

Report

PSYCHOPHYSIOLOGICAL ASSESSMENT OF BUDDHIST TAIWANESE CHANTING: *A CASE REPORT*

I. M. Lin; E. Peper; W. C. Lin; G. H. Long; A. Burke; & C. Y. Weng

ABSTRACT

The psychophysiological responses and subjective experience correlates of Buddhist chanting were recorded from a 54 year-old female Buddhist monk who performed chanting for approximately 30 to 60 minutes twice daily for 25 years. The measures included respiration rate from upper thorax, blood volume pulse (BVP) from left middle finger with heart rate derived from BVP, finger temperature from right index finger, skin conductance (SC) from the left index finger and the ring finger and surface electromyographic (sEMG) from right trapezius and left sternocleidomastoid muscles (SCM) and were recorded during normal chanting sequence which included reading sutra aloud with her eyes open (chanting "The Samanta-Mukha") and silent mental repetition of sutra with the eyes closed (chanting "The Heart Sutra" inside her mind). After chanting she reported feeling peaceful, more relaxation with a total focus of attention and "consciousness"—an experience that was similar to when she chanted in the temple with other monks. The most significant finding was that respiration rate changed from 7.2 br/min during pre-baseline, to 12.1 br/min during reading sutra aloud, 5.7 br/min during silent mental repetition of sutra and 7.5 br/min during post-baseline. Respiratory sinus arrhythmia (RSA) was significantly higher during post-baseline than reading chanting and silent mental repetition of sutra. All physiological measures were significantly different for each condition. This study suggests that the subjective experience associated with chanting can not be attributed to increased RSA and slower breathing as it depends upon the style of chanting. The spiritual experience associated with chanting appears to be evoked through the focused attention on the sutra.

KEYWORDS: Chanting, meditation, Buddhist monk, respiration, RSA, biofeedback

BACKGROUND

Chanting, a common practice in many spiritual traditions and research, can induce peaceful states and constitute a foundation of Buddhist mental and character training.^{1,2} Benefits of chanting include stabilization of attention and the reduction of intrusive thinking. These chanting techniques help train the mind to be tranquil, identify and defuse sources of negative emotions, and increase empathy which may facilitate the cultivation of moral character to benefit others through the intentional use of chanting. In Taiwan, Buddhist monks chant sutras (classic Buddhist canonical scriptures) and this is typically performed in the morning (choka sutra chanting) and again in the evening (banka sutra chanting). In most cases chanting is part of structured spiritual practices that include initiating and concluding rituals such as making prostrations, representing respect for the teacher and lineage, and cultivating humility. Through these practices practitioners have reported experiencing peaceful states. A major research question is what are the mechanisms for the induced subjective change that occurs during chanting. Bernardi et al. proposed that increased respiratory sinus arrhythmia (RSA) especially if time locked with the breathing cycle and increased cardio-respiratory synchrony (CRS) is an underlying mechanism.³ He observed significant increases in RSA, slowing of respiration to about 6 breaths per minute, and increased baroreflex sensitivity during recitation/chanting of the Ave Maria rosary and yoga mantras. This study investigates whether RSA and CRS is the common mechanism that underlies the subjective changes in experience during meditative chanting by exploring the psychophysiological and subjective experience correlates of an experienced Buddhist monk who chants twice daily and reports relaxation and reported internal peacefulness.

METHODS

SUBJECT

The subject was a 54 year-old female Taiwanese monk with 25 years of experience with chanting. She practices sutra chanting twice daily with other monks in the morning and in the evening, for approximately 30 to 60 minutes as well as chanting alone in her free time.

EQUIPMENT

The BioGraph Infiniti™ version 3.0 (Thought Technology Ltd., Montreal, Quebec, Canada) was used to collect psychophysiological data with a sampling rate of 256 samples per second from the subject. Sensors placement and equipment settings were as follows:

- Thoracic respiration was monitored with a strain gauge around the chest underneath the axilla and above the breasts.
- Blood volume pulse (BVP) with a BVP sensor attached to the distal phalange of her left middle finger.
- Finger temperature (TEMP) was monitored from the medial side of the distal phalanx of the index finger.
- Skin conduction (SC) was monitored with two conductive straps attached to the proximal phalange segment of the left index and ring fingers.
- Surface Electromyography (SEMG) was monitored with Myoscan sensors using Triode™ electrode with the bandpass filter set between 100-200Hz. The EMGs were recorded from the center of the right upper trapezius and from the midpoint of the left sternocleidomastoid muscle.
- All channels were sampled at 256 Hz.

PROCEDURE

The subject sat in a softly lit room. The temperature was maintained at 28° C. The procedure monitored the subject in a similar sequence in which she habitually chanted. While chanting, the subject wore a Kesa (Buddhist liturgical robe), and sat with crossed legs on the floor in front of a Buddhist statue (Figure 1).

The procedure consisted of monitoring the monk in the following sequence: (1) sensor attachment and signal calibration for 10 minutes; (2) pre-baseline sitting (eyes closed) for 6 minutes; (3) reading sutra aloud: subject opened her eyes and read aloud from the Samanta Mukha Sutra (a portion of the Lotus Sutra) for 14 minutes; (4) closed eye mental repetition of the Prajna Paramita Hrydaya Sutra (the Heart Sutra) for 1 minute; (5) control condition of reading a neutral text out load: subject opened her eyes and read a neutral text for 1 minute; and (6) post baseline (eyes closed sitting) for 5 minutes. The sequence

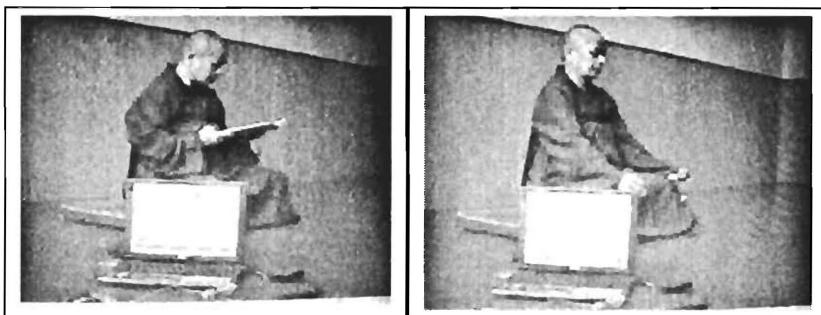


Figure 1. Subject reading sutra aloud and silent mental repetition of sutra.

of the experimental procedure is shown in Figure 2. The lengths of reading sutra aloud and silent mental repetition were determined by the monk and represented her normal practice pattern. After recording, the monk described her subjective experience and also compared this to her temple chanting experiences. Finally the data was shown to the monk to discuss observations and insights.

DATA ANALYSIS

Heart rate and respiration rate were visually inspected and scored only during artifact free periods. Heart rate was derived from the BVP signal. Respiration rate was visually scored by counting each breath during artifact free periods. After deletion of artifact, the data was used for analysis of respiration, heart rate, temperature, skin conductance, and EMG.

RESULTS

During reading sutra aloud and silent mental repetition of sutra, the monk experienced feelings of relaxation and peacefulness and that the reading sutra aloud practice helped her to let go of any negative thoughts and psychological needs. She reported that the subjective experience during the research study was similar to her experience when doing these practices in the temple. She also reported being able to stay focused after an initial sense of self-awareness due to the measurement process. She was able to remove distractive thoughts

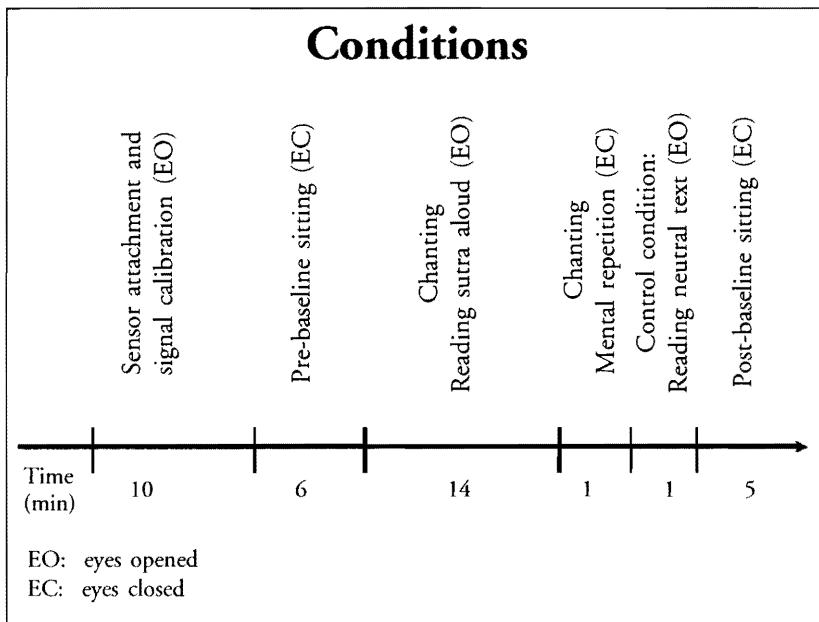


Figure 2. Experimental procedure.

and attend to the Sutras and bring her mind and body together. She reported that silent repetition produced the most relaxed and peaceful state. During the reading aloud of neutral text she felt tense and could not easily focus her awareness on the unfamiliar text.

There were significant physiological differences between reading sutra aloud and the silent repetition, reading text and baseline. During silent repetition, her respiratory rate was very slow and regular, both EMG were low and no demonstrative RSA. During reading sutra and reading neutral text the subject's respiration rate became shallow and quick, and the heart rate increased and was more irregular shown in Figure 3.

During the pre- and post-baseline conditions the subject's respiration rate was very slow and smooth, and respiratory sinus arrhythmia was significantly higher than during reading sutra aloud and silent repetition. Cardio Respiratory Synchrony/RSA was most prevalent during post-baseline as shown in Figure 4.

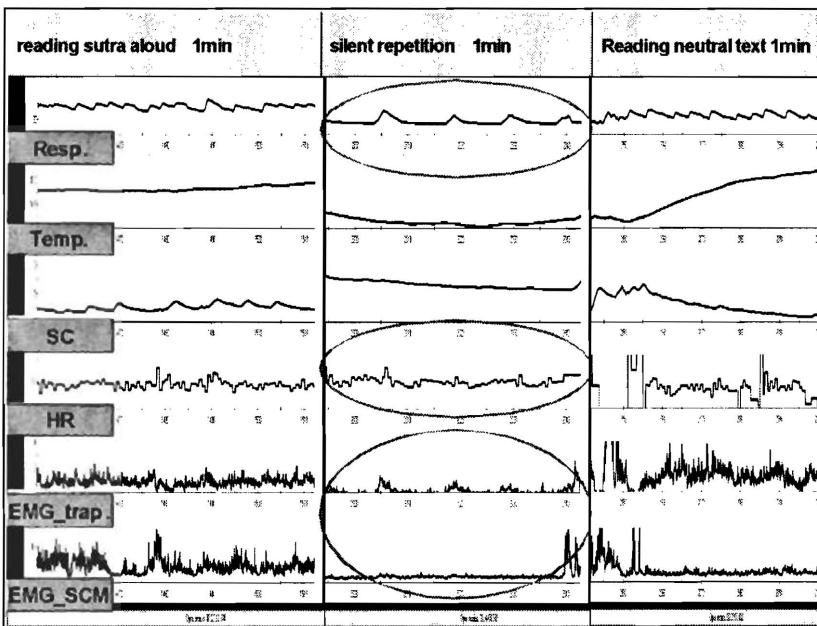


Figure 3. Representative 60 second recording of reading sutra aloud, silent repetition, and reading neutral text aloud. During reading sutra aloud and reading neutral text the subject's respiration rate became shallow and quick, and the heart rate increased and was more irregular. During silent repetition her respiration rate was slow and regular and activation of both trapezium and throat muscles' EMG were low.

Overall, lower arousal was measured during silent repetition as compared to reading sutra aloud in respiration rate, heart rate, skin conductance and EMG, as shown in Table I. One-way ANOVAs showed that mean respiration rate was significantly different between all conditions ($F = 359621$; $p < 0.001$); mean skin conductance was significantly different between all conditions ($F = 15297$; $p < 0.001$); mean skin temperature was significantly different between all conditions ($F = 825815$; $p < 0.001$); mean trapezius SEMG was significantly different between all conditions ($F = 31733$; $p < 0.001$). There was no significant difference between pre- and post-baseline and significant difference between silent repetition, reading sutra aloud and reading neutral text ($F = 37040$; $p < 0.001$); mean Heart rate was significantly different between pre-baseline, reading sutra aloud and post-baseline ($F = 14185$; $p < 0.001$), there was no difference between post-baseline and reading neutral text. Visual

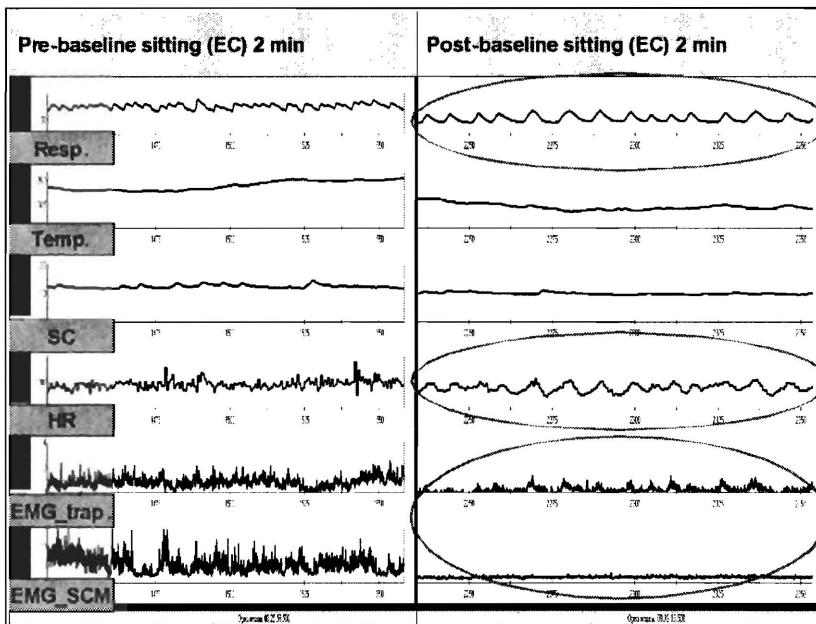


Figure 4. Two minute physiological recording comparing pre-and post-baseline. Note the significant CRS/RSA during the post-baseline condition.

inspection for CRS showed most CRS during the pre- and post-baseline and significantly less during and silent repetition, reading sutra aloud and reading neutral text, although there was more CRS during silent repetition than reading sutra aloud.

A detailed analysis between the first part and the last part of the reading sutra aloud showed a significant decrease in SCM SEMG as shown in Figure 5.

DISCUSSION

The monk reported that she experienced relaxation and peacefulness that was similar to that experienced during chanting in the temple. Her subjective feeling of peacefulness developed during the reading sutra aloud meditation and was maintained during her silent meditation. Her physiology is different in

Table I
Means and standard deviations of physiological measures across conditions

Condition	pre-baseline sitting (eyes closed)	reading chanting (eyes open)	silent mental repetition of sutra (eyes closed)	reading neutral text (eyes open)	post-baseline sitting (eyes closed)	F-test & Scheffe Post Host test
Resp rate	7.2	12.1	5.7	13.3	7.5	$p < 0.001$
HR*	88.6 (4.9)	7.5 (10.65)	100.9 (9.43)	92.2 (16.88)	92.0 (12.05)	$p < 0.001$
Temp*	35.9 (0.11)	34.9 (0.19)	34.1 (0.05)	34.8 (0.38)	34.5 (0.14)	$p < 0.001$
SC*	1.2 (0.17)	1.2 (0.17)	1.3 (0.11)	1.3 (0.17)	1.1 (0.15)	$p < 0.001$
EMG-Trap*	0.3 (0.32)	0.7 (0.52)	0.1 (0.35)	1.5 (1.74)	0.1 (0.42)	$p < 0.001$
EMG-SCM*	1.8 (1.12)	4.3 (2.33)	2.0 (1.65)	3.3 (3.28)	1.8 (1.33)	$p < 0.001$

* mean
(SD)

these two conditions and showed no increased RSA/CRS. Increased RSA/CRS occurred mainly during the post-baseline condition. Consequently, her subjective experience can not be explained through an increase in CRS or decrease in breathing rate as she reported a similar sense of peacefulness during reading sutra aloud with a breathing rate of 12.1 per min as compared to the silent repetition with a breathing rate of 5.7 per minute. When comparing the control condition of reading neutral text, the physiological patterns are not significantly different from reading sutra aloud. It seems that reading sutra aloud meditation allowed her to focus her attention and concentration which slowly transformed into peaceful relaxation.

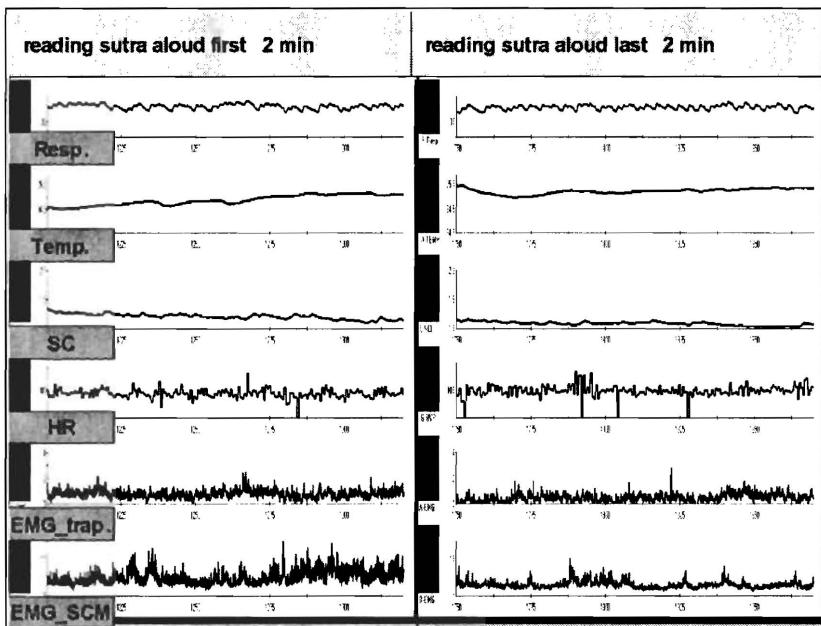


Figure 5. Physiological recording during the first 2 minutes and last 2 minutes of reading sutra aloud.

Her subjective experiences during the reading sutra aloud appeared to correlate with physiological recording. In the first 5 minutes she reported some stress because she couldn't memorize the sutra while reading the sutra. After 5 minutes, she adapted the situation and could concentrate. At the end of the reading sutra aloud, she experienced the same feelings as she chanting with other monks in the temple. By the end of reading sutras aloud, her trapezius and SCM SEMG were lower, her temperature increased and her SCL decrease as compared to the beginning of the reading aloud. The measures suggest that her sympathetic arousal decreased. The physiology appears to be an indicator of her relaxed concentration during chanting as shown by the decrease in SCM and Trapezius SEMG and slight increase in temperature and decrease in SCL especially as compared to the reading of neutral text.

Although both sutra reading and neutral text reading increased heart and breath rate, the subject found the reading of sutra to be very relaxing and producing

of a state of peace compared to neutral text. Also, the internal silent repetition of the Heart Sutra was reported by the monk to be the most relaxing of the three conditions. During silent repetition there was an observed reduction in respiration. Interestingly, however, there was no decrease in heart rate. Skin conductance and temperature similarly did not reflect increased relaxation. One plausible reason for this finding is that the subject reported concern about performing the practices for the researchers. Such performance concerns could have impacted the physiological findings however, she reported that after 5 minutes it was not of any concern to her. It could also reflect a difference in the physiological effects resulting from the psycho-emotional content of the texts, beyond the physical effects of chanting.

Possibly, the physiological changes generated by the Buddhist sutras are designed to evoke an empathic awareness in the practitioner. The Buddhist sutras, at least as chanted in Taiwan, may have a different cadence and meter and this may not produce the psychophysiological rhythms as in other practices. Indeed chants in Mahayana Buddhist traditions are devoted to development of empathy which may place a higher premium on mindfulness and some level of arousal or heart activation. This may be less likely to arise in Western experimental subjects chanting “Om Mani Padme Hum” or the rosary as reported by Bernardi.³

Contrary to Bernardi’s study in which each cycle (and break) of the Ave Maria “. . . took almost exactly 10 seconds” and thereby produced a desirable 6 breath per minute cycle resulting in an entrainment of RSA/CRS pattern, the study showed that chanting did not produce the 6 breaths per minute breathing cycle or the increase in RSA. Consequently, CRS/RSA can not be the major reason underlying this Buddhist monk’s experience of peacefulness.

Most likely, the major mechanism that underlies the change in subjective experience is not the CRS/RSA entrainment but the mental concentration on the sutras without experiencing distracting by thoughts and feelings. It could be hypothesized that the mantra chanting, evolved in countries with long histories of intentional breath control practices for cultivation of spiritual states, would have a similar intrinsic pattern. More research comparing diverse systems and practices would be valuable, with an expanded focus on not just physiological. Further research should be conducted with a group of individuals who chant

regularly as well as comparing different chanting styles such as singing chanting and reading chanting.

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